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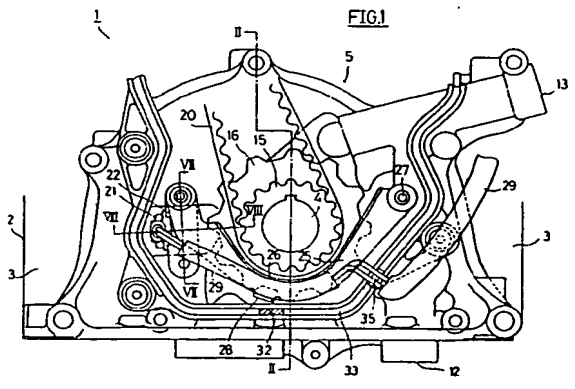
(54) Timing belt tooth skip preventer.

(57) A structure for preventing a tooth skip in a toothed endless power transmitting belt is provided. On an inner side of a tooth skip preventing member 25 covering an outer surface of a toothed rotor 19 is formed a tooth skip preventing piece 26 bent at a right angle. The tooth skip preventing member is arranged in substantially parallel to the outer circumferential surface of the toothed endless power transmitting belt 20 wound around a toothed driving pulley 15 with a narrower space than a tooth height of the pulley. The tooth skip preventing member is fixed to a casing 7 by a bolt penetrating a hole 27 of the member. On a outer side at a central portion of the tooth skip preventing member 25 is formed a harness holding piece 28 bent at a right angle in the same direction as the tooth skip preventing piece 26.

FIG.1



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BACKGROUND OF THE INVENTION

This invention relates to a structure for preventing a tooth skip of an endless power transmitting means.

A tooth skip preventing device for a toothed endless power transmitting belt is disclosed in a gazette of Japanese Utility Model Laid-open No. Sho 55-161157.

In the tooth skip preventing device for the toothed endless power transmitting belt disclosed in the aforesaid gazette, the tooth skip preventing member for restricting the toothed endless power transmitting belt wound around the pulley from being moved toward a radial direction of the pulley was merely and directly fixed to the main body of an internal combustion engine at the main body side of a power transmitting device and the tooth skip preventing member had no function other than the above.

In addition, the tooth skip preventing piece of the tooth skip preventing member was in parallel in respect to a rotating axis of the pulley from its abutting edge against the main body of an internal combustion engine up to its outer free edge, and a fixing piece bent at a right angle from the inner end edge of the tooth skip preventing piece was abutted and fixed to the main body of the internal combustion engine, resulting in that a rotational angle sensing rotary member having a larger diameter than that of the pulley could not be arranged between the pulley and the main body of the internal combustion engine.

SUMMARY OF THE INVENTION

This invention relates to an improvement of a tooth skip preventing structure of an endless power transmitting means overcoming such problems described as above and provides a tooth skip preventing structure of an endless power transmitting means wound around a toothed driving rotary member and a toothed driven rotary member, characterized in that a tooth skip preventing piece of a tooth skip preventing member is arranged along an outer circumferential surface of said endless power transmitting means wound around said rotary member with a narrower space than a tooth height of said rotary member from said outer circumferential surface, a rotor acting as a detected object having a larger diameter than that of said toothed rotary member is arranged at a pivoted base part of said toothed rotary member adjacent to a rotational angle detecting sensor, and said tooth skip preventing member is arranged adjacent to said rotor so as to cover an outer surface of said rotor.

Since the present invention is constructed as described above, even if the endless power transmitting means wound around the toothed rotary member becomes apt to ride over the teeth of the toothed rotary member under a high tension or vibration or the like, the back surface of the endless power transmitting means is abutted against the tooth skip preventing piece of the tooth skip preventing member so as to prevent a tooth skip of the power transmitting means in advance.

In addition, since the tooth skip preventing member can be arranged to cover the outer surface of the rotor acting as a detected object having a larger diameter than that of the toothed driving rotary member, adhesion of foreign material to the rotor can be reduced as much as possible and an accuracy in detecting of a rotational angle can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front elevational view for showing a state in which a timing belt cover is removed in one preferred embodiment of the endless power transmitting means;

Fig. 2 is a longitudinal side elevational view in section taken along a line II-II in Fig. 1 of a state in which an auxiliary machine driving pulley and a timing belt cover are installed;

Fig. 3 is a front elevational view for showing a tooth skip preventing member in the preferred embodiment shown in Fig. 1;

Fig. 4 is a view taken along an arrow line IV-IV of Fig. 3;

Fig. 5 is a cross sectional view taken along a line V-V of Fig. 3;

Fig. 6 is a longitudinal section taken along a line VI-VI of Fig. 3;

Fig. 7 is a longitudinal section taken along a line VII-VII of Fig. 1;

Fig. 8 is a cross sectional view taken along VIII-VIII of Fig. 1,

Fig. 9 is a cross sectional view for showing a part similar to Fig. 8 of another preferred embodiment;

Fig. 10 is a front elevational view for showing a tooth skip preventing member of a still further preferred embodiment;

Fig. 11 is a cross sectional view taken along a line XI-XI of Fig. 10; and

Fig. 12 is a longitudinal section for showing a substantial part of a still further preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to Figs. 1 to 8, one preferred embodiment of the present invention applied to the internal combustion engine will be described as

follows.

A four-cycle internal combustion engine 1 of an over-head cam type is installed on a vehicle not illustrated with its crank shaft 4 being directed in a width of the vehicle. The crank shaft 4 passes through a side wall 3 of a cylinder block 2 and projects from it. A rotor 6 of an oil pump 5 is fitted to a projecting base portion of the crank shaft 4. When the crank shaft 4 is rotated, the rotor 6 of the oil pump 5 is also rotationally driven integrally with the crank shaft 4.

In addition, the rotor 6 of the oil pump 5 is rotatably fitted within a rotor chamber 8 of the casing 7, sealingly closed by a lid 9. Both a suction port 10 and a discharging port 11 communicating with the rotor chamber 8 are formed in the casing 7 and each of the suction port 10 and the discharging port 11 is communicated with a suction passage 12 and a discharging passage 13, respectively. An oil seal 14 is provided between the crank shaft 4 and the casing 7.

A toothed driving pulley 15 for driving a valve moving mechanism, a belt position restricting guide plate 17 and an auxiliary machine driving pulley 18 are fitted with keys in sequence to the extremity end of the crank shaft 4 projected from the casing 7 of the oil pump 5. The toothed driving pulley 15 and the auxiliary machine driving pulley 18 are integrally fitted to the crank shaft 4 with bolt 19 threadably fitted to a threaded hole at the extremity end surface of the crank shaft 4. A toothed endless timing belt 20 acting as a toothed endless power transmitting means is wound around the toothed driving pulley 15 and a toothed driven pulley not shown at the upper part of the 4-cycle internal combustion engine 1, wherein a rotational force of the crank shaft 4 is transmitted to the toothed driven pulley through a toothed driving pulley 15 and the toothed endless timing belt 20 and then a valve moving cam (not shown) integral with the toothed driven pulley is rotationally driven.

A toothed rotor 16 acting to restrict a position of the belt and to detect a rotational angle of the crank shaft 4 is concentrically and integrally formed at the toothed driving pulley 15. These toothed driving pulley 15 and the toothed rotor 16 are of ferromagnetic member such as steel. A rotational angle sensor 21 is arranged adjacent to the toothed rotor 16.

The rotational angle sensor 21 is integrally fitted to a sensor holder 22 of synthetic resin. A lower base end (a right end in Fig. 7) of the sensor holder 22 is connected to the casing 7 of the oil pump 5 through a pin 23 and at the same time the upper base end (a left end in Fig. 7) of the sensor holder 22 is integrally connected to the casing 7 by a bolt 24 which passes through one end (a left end in Fig. 1) of a tooth skip preventing member 25 and the upper base end of the sensor holder 22 and is threadably fitted to the casing 7. A pulse is transmitted from the rotational angle sensor 21 in response to a variation in magnetic flux generated every time the teeth of the toothed rotor 16 pass near the rotational angle sensor 21.

The tooth skip preventing member 25 covers the outer surface of the toothed rotor 16. A tooth skip preventing piece 26 is formed inside the tooth skip preventing member 25 being bent at a right angle from the member 25. The tooth skip preventing piece 26 is arranged to be positioned in substantial parallel to an outer circumferential surface of the endless timing belt 20 wound around the toothed driving pulley 15 with a narrower space than a tooth height of the toothed driving pulley 15 between the piece 26 and the outer circumferential surface. The tooth skip preventing member 25 is integrally fixed to the casing 7 by a bolt (not shown) which passes through a threaded hole 27 at the other end of the tooth skip preventing member 25 to be screwed to the casing 7.

In addition, a harness holding piece 28 bent substantially at a right angle in the same direction as that of the tooth skip preventing piece 26 is formed outside the substantial central part of the tooth skip preventing member 25. A harness 29 for transmitting a detecting pulse from the rotational angle sensor 21 is placed along the tooth skip preventing member 25 and at the same time it is held between the tooth skip preventing piece 26 and the harness holding piece 28.

The casing 7 of the oil pump 5 is formed with a cover abutting part 33 against which a peripheral edge 31 of a timing cover 30 covering the space around the toothed endless timing belt 20 is abutted through an O-ring 34. A part of the casing 7 adjoining to the peripheral edge 31 is provided with a water drain hole 32 (a location of hatching in Fig. 1 and this may not be a hole, but a recess). The timing belt cover 30 is removably attached to the cover abutting part 33 of the casing 7 by means of a bolt not shown.

The peripheral edge 31 of the timing belt cover 30 and the cover abutting part 33 of the casing 7 are formed with recesses 35 at the location where the harness 29 traverses.

Since the preferred embodiment shown in Figs. 1 to 8 is constructed as described above, as the crank shaft 4 is rotated, the valve moving cam is rotationally driven through the toothed driving pulley 15, the toothed endless timing belt 20 and the toothed driven pulley not shown. A suction valve and a discharging valve not shown are opened or closed at a predetermined timing and at the same time a pulse is transmitted from the rotational angle sensor 21 in response to a rotational angle of the crank shaft 4.

Even if a high tension or vibration is applied to the toothed endless timing belt 20, resulting in that the tooth of the toothed endless timing belt 20 become apt to ride over the tooth of the toothed driving pulley 15, the outer surface of the toothed endless timing belt 20 is abutted against the tooth skip preventing piece 26 of the tooth skip preventing member 25 arranged outside it and then a tooth skip is prevented in advance.

In addition, the harness 29 connected to the rotational angle sensor 21 is abutted against the main body of the tooth skip preventing member 25 and the tooth skip preventing piece 26 and at the same time the harness 29 is held by the harness holding piece 28 and the tooth skip preventing piece 26, so that the harness 29 is stably held.

Since both ends of the tooth skip preventing member 25 are integrally fixed to the casing 7 of the oil pump 5 at locations spaced apart in a radial direction from the outer circumference of the toothed rotor 16, it is possible to arrange the tooth skip preventing piece 26 of the tooth skip preventing member 25 adjacent to the toothed driving pulley 15 without being hindered by the toothed rotor 16 having a larger diameter than that of the toothed driving pulley 15 and at the same time the outside part of the toothed rotor 16 is covered by the tooth skip preventing member 25 so as to enable some foreign materials to be prevented from being adhered to the toothed rotor 16 and then an accuracy in detecting a rotational angle can be improved.

Since a space near the toothed endless timing belt 20 is covered by the casing 7 of the oil pump 5 and the timing belt cover 30, it is possible to prevent some foreign materials or the like from entering the device.

Since the bottom part of the timing belt cover 30 is provided with the water drain hole 32, water or the like condensed at a space enclosed by the casing 7 and the timing belt cover 30 can be positively discharged out through the water drain hole 32.

Since the main body of the tooth skip preventing member 25 is arranged at the toothed rotor 16 rather than at the water drain hole 32, even if the foreign materials enter from the water drain hole 32 into the timing belt cover 30, adhesion of the foreign materials to the toothed rotor 16 can be prevented as much as possible.

The toothed rotor 16 may act as one for restricting the belt position and is integrally formed with the toothed driving pulley 15, so that the number of component parts is less, the device is constructed in compact and then both light weight and low cost of the device can be attained.

Although the preferred embodiment shown in Figs. 1 to 8 is constructed such that the tooth skip preventing piece 26 of the tooth skip preventing member 25 is bent substantially at a right angle in respect to the main body of the tooth skip preventing member 25, the tooth skip preventing piece 26 may be bent over 90° in respect to the main body of the tooth skip preventing member 25, as shown in Fig. 9, in this embodiment, the tooth skip preventing piece 26 is inclined so as to approach the toothed endless timing belt 20 from the outer edge 26a of the tooth skip preventing piece 26 toward the bent edge 26b, thereby a space between the toothed driving pulley 15 and the tooth skip preventing piece 26 of the tooth skip preventing member 25 is widened toward the outside, resulting in that it can be easily performed to attach or detach the toothed endless timing belt 20.

In addition, as shown in Fig. 9, in the case that the main body of the tooth skip preventing member 25 is arranged to cover the outer side surface of the rotor 16, an effect of preventing foreign materials from being adhered to the rotor 16 can be improved.

It may also be applicable that the harness holding piece 28 is eliminated and the harness 29 is held by the timing belt cover 30 and the main body of the tooth skip preventing member 25. In such a preferred embodiment, it is possible to make a positive prevention of floating of the harness toward the timing belt cover 30 and further if the harness holding piece 28 is also applied, a supporting force of the harness 29 can be more improved.

In a preferred embodiment shown in Figs. 10 and 11, a base part 38 of a fixing band 37 is fitted to a fixing hole 36 formed in the tooth skip preventing member 25. The fixing band 37 is wound around the harness 29, and the extremity end of the fixing band 37 is inserted into a hole (not shown) formed in the base part 38 of the fixing band 37, thereby the harness 29 may be fixed to the tooth skip preventing member 25. Also in the preferred embodiment, the harness 29 can be positively held at the tooth skip preventing member 25.

Although in the preferred embodiment shown in Figs. 1 to 8, both ends of the tooth skip preventing member 25 are integrally fixed to the casing 7 of the oil pump 5, as shown in Fig. 12, both ends of the tooth skip preventing member 25 may be integrally fixed to the metallic timing belt cover 30 with bolt and the like.

In the aforesaid preferred embodiments, the present invention is applied to the toothed timing belt power transmitting device and it is also apparent that the present invention can be applied to a chain power transmitting device.

Claims

1. A tooth skip preventing structure of an endless power transmitting means wound around a toothed driving rotary member and a toothed driven rotary member, characterized in that a tooth skip preventing piece of a tooth skip preventing member is arranged along an outer circumferential surface of said endless power transmitting means wound around said rotary member with a narrower space than a tooth height of said rotary member from said outer circumferential surface, a rotor acting as a detected object having a larger diameter than that of said toothed rotary member is arranged at a pivoted base part of said toothed rotary member adjacent to a rotational angle detecting sensor, and said tooth skip preventing member is arranged adjacent to said rotor so as to cover an outer surface of said rotor.

2. A tooth skip preventing structure of an endless power transmitting means according to Claim 1, characterized in that said rotor, said toothed rotary member, said endless power transmitting means and said tooth skip preventing member are arranged within a power transmitting means cover member provided with a water drain hole below said toothed rotary member and said rotor, and the tooth skip preventing member covering an outer surface of said rotor is arranged adjacent to said water drain hole.

3. A tooth skip preventing structure of an endless power transmitting means according to Claim 1 or 2, characterized in that a back surface of said tooth skip preventing piece of said tooth skip preventing member is applied as a supporting surface of a linear member.

4. A tooth skip preventing structure of an endless power transmitting means according to any of claims 1 to 3, characterized in that said tooth skip preventing piece of said tooth skip preventing member is inclined so that a space between said piece and the outer circumferential surface of said endless power transmitting means wound around said rotary member is increased in a direction going away from the pivoted base side surface of said toothed rotary member.

5. A tooth skip preventing structure of an endless power transmitting means according to claim 3, characterizing in that said linear member is held by said toothed skip preventing member and a power transmitting means cover.

6. A tooth skip preventing structure of an endless power transmitting means according to any of claims 1 to 5, characterized in that said rotational angle detecting sensor is fixed to a casing of an oil pump.

7. A tooth skip preventing structure of an endless power transmitting means according to claim 6, characterized in that said rotational angle detecting sensor is integrally fitted to a sensor holder of synthetic resin.

8. A tooth skip preventing structure of an endless power transmitting means according to claim 6, characterized in that said rotational angle detecting sensor is integrally fitted to a sensor holder of synthetic resin, and both said sensor holder and said tooth skip preventing member are fastened to said casing of the oil pump by a common fastening means.

9. A tooth skip preventing structure of an endless power transmitting means according to claim 3, characterized in that said linear member is a harness connected to a rotational angle detecting sensor.

10. A tooth skip preventing structure of an endless power transmitting means according to claim 9, characterized in that said harness is held between said tooth skip preventing piece of the tooth skip preventing member and harness holding piece formed on said tooth skip preventing member opposite to said tooth skip preventing piece.

11. A tooth skip preventing structure of an endless power transmitting means according to Claim 2, wherein a main body of said tooth skip preventing member is disposed on the side of said rotor with respect to said water drain hole.

FIG.1

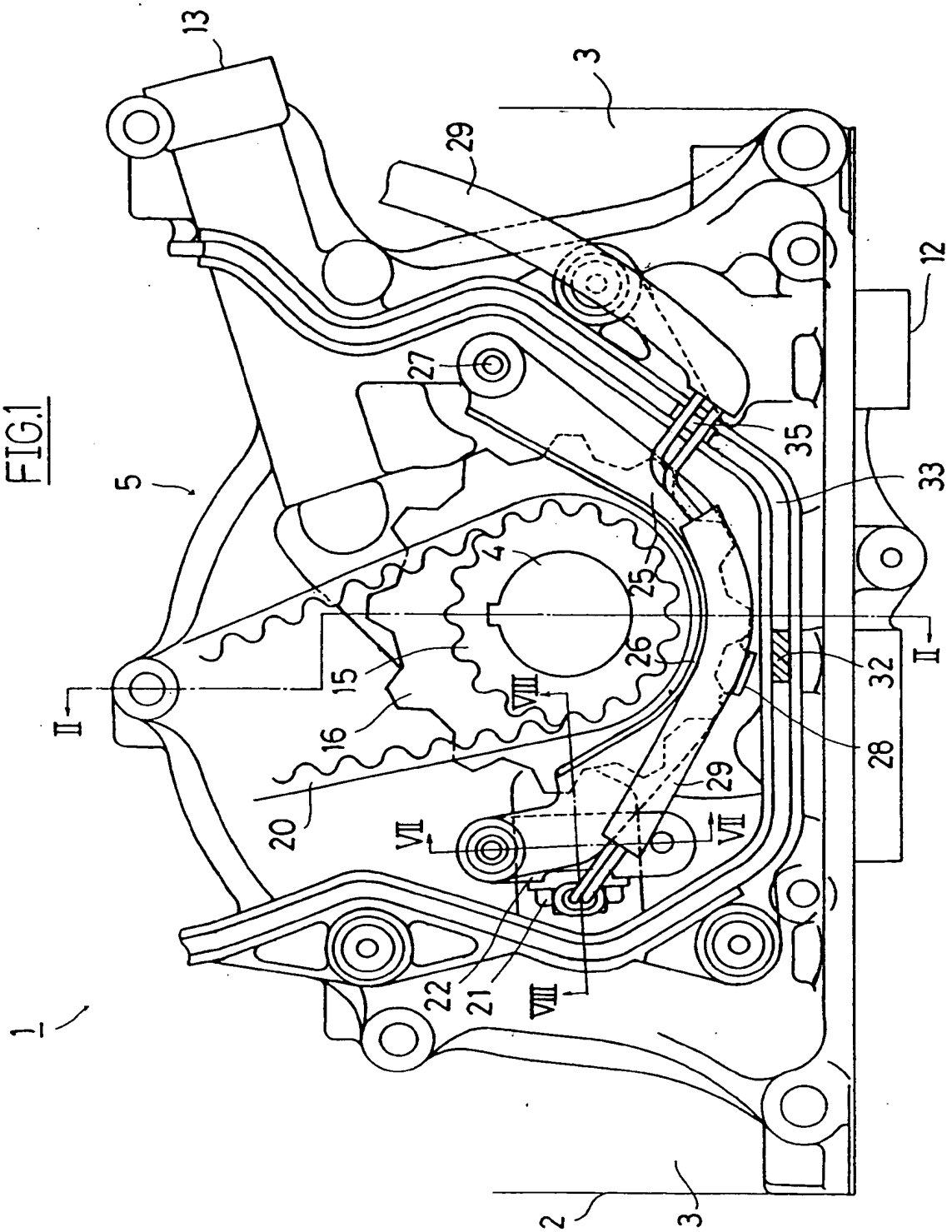


FIG.2

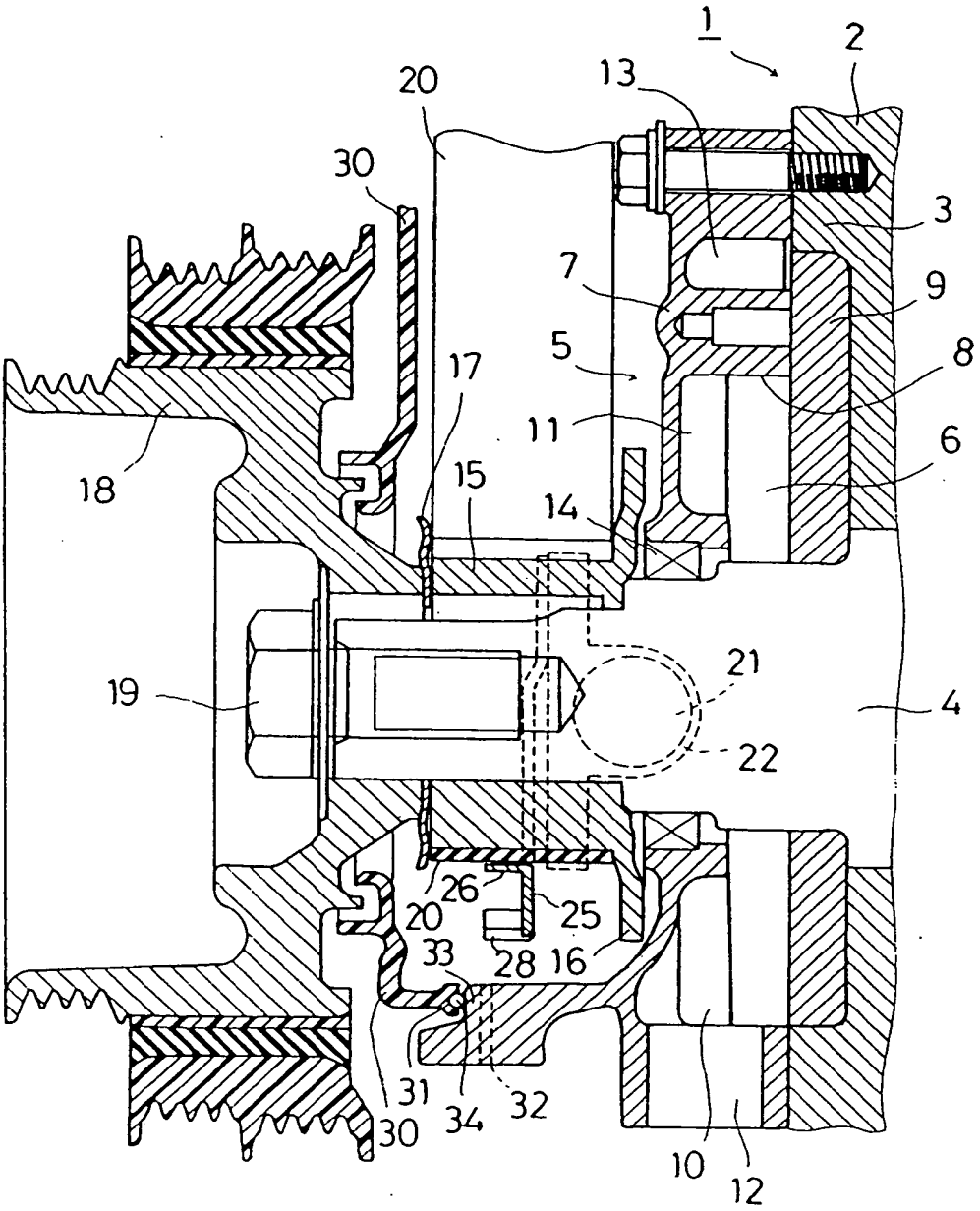


FIG.3

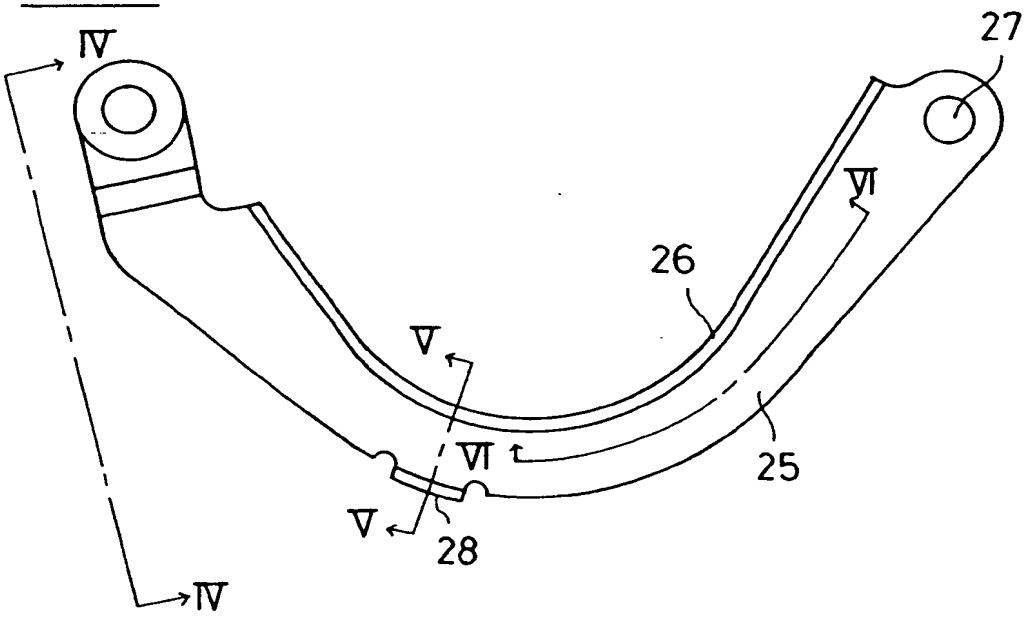


FIG.4

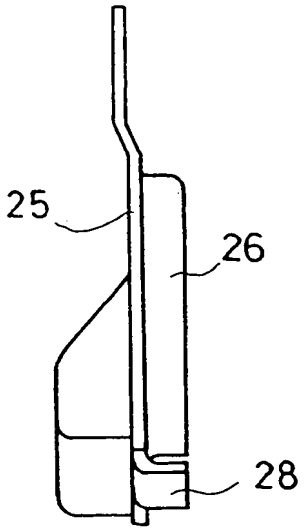


FIG.5

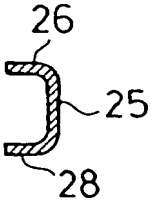


FIG.6

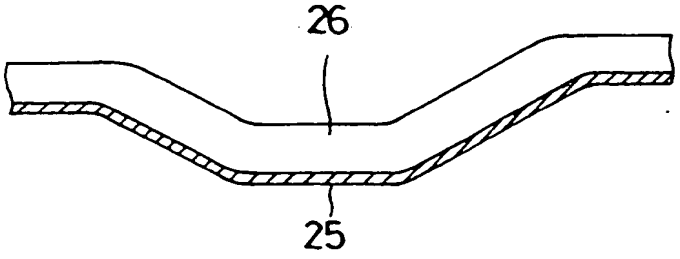


FIG.7

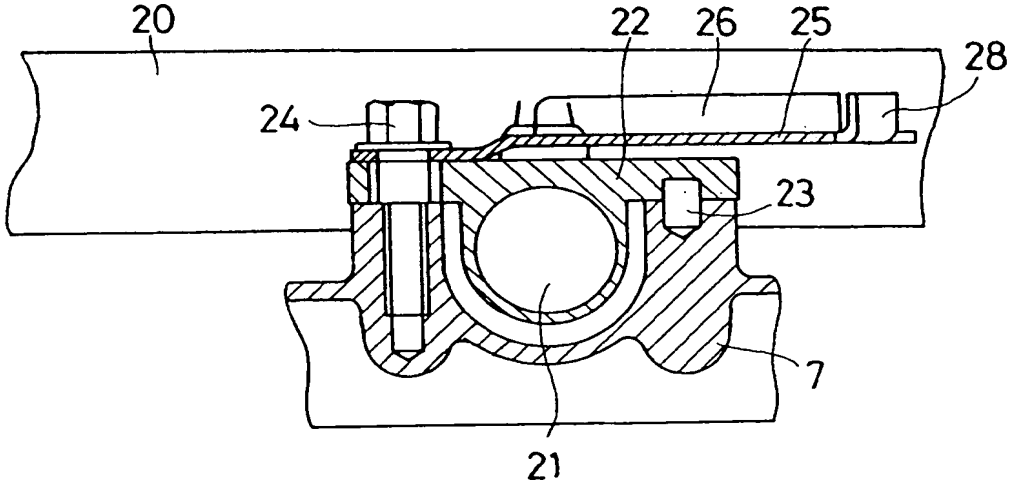


FIG.8

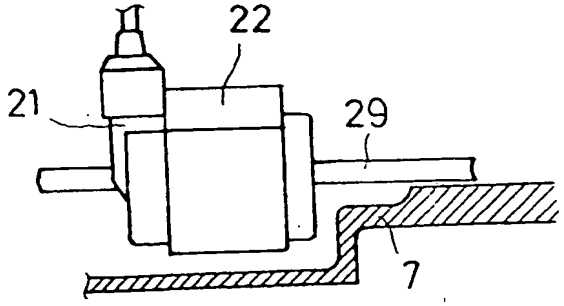


FIG.9

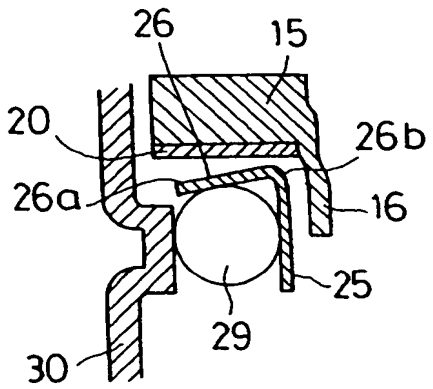


FIG.10

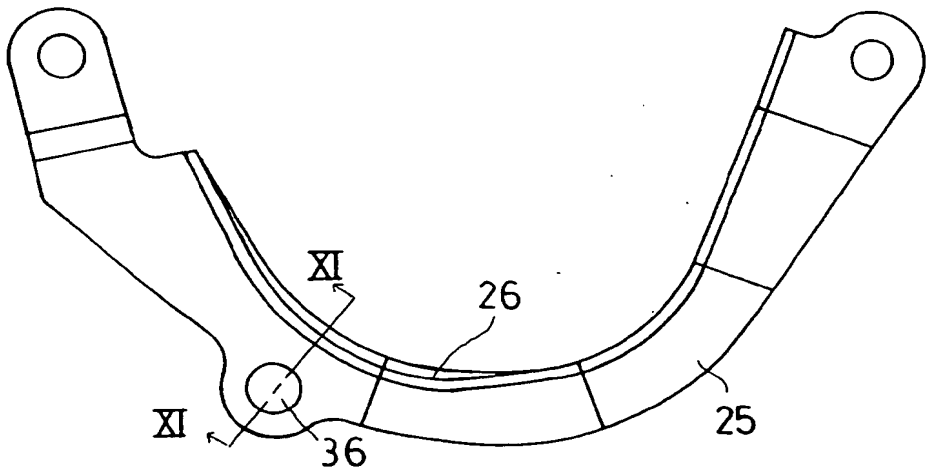


FIG.11

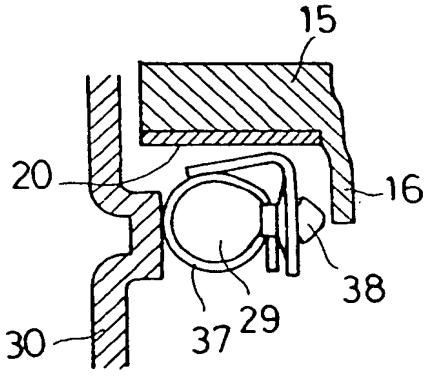
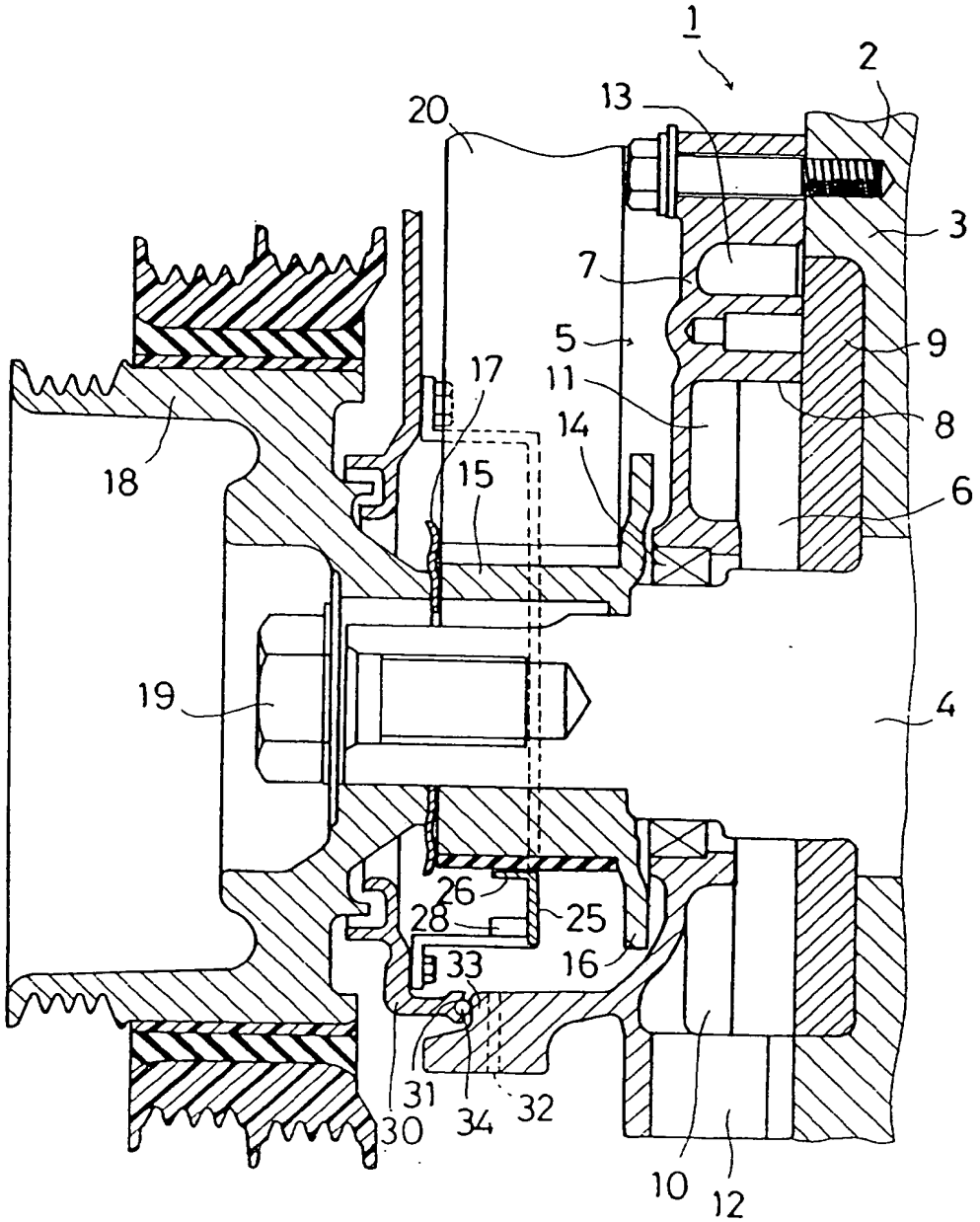


FIG.12



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EUROPEAN SEARCH REPORT

Application Number
EP 95 10 3888

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-33 28 677 (VOLKSWAGEN) * the whole document *	1	F16H7/02 F02B77/08 F16H7/18
A	GB-A-2 114 260 (FORD) * abstract; figure 3 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 8 no. 270 (M-344) [1707] ,11 December 1984 & JP-A-59 140954 (HINO JIDOSHA KOGYO) * abstract *	1	
D,A	JP-U-55 161 157 (.....) * figure 1 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F16H
F02B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 June 1995	Flores, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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